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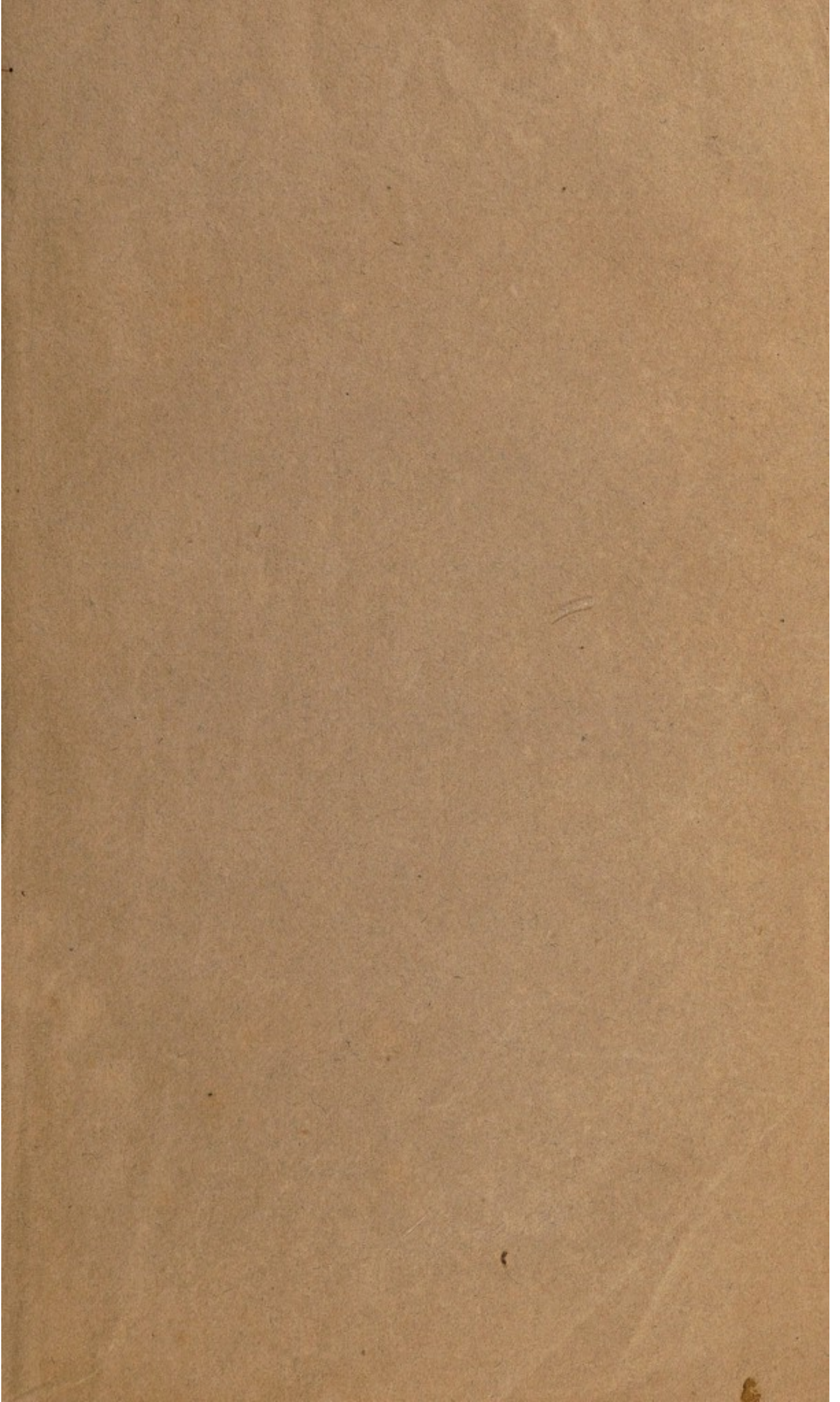
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A  
PROBATIONARY ESSAY  
ON  
**AMPUTATION**  
**IN CASES OF EXTERNAL INJURY;**

SUBMITTED,

BY THE AUTHORITY OF THE PRESIDENT AND HIS COUNCIL,

TO

**THE EXAMINATION**

OF THE

**Royal College of Surgeons of Edinburgh,**

WHEN CANDIDATE

FOR

*ADMISSION INTO THEIR BODY;*

IN CONFORMITY TO THEIR REGULATIONS RESPECTING THE ADMISSION  
OF ORDINARY FELLOWS,

BY

**ALEXANDER WATSON,**

SURGEON,

=====  
OCTOBER, 1821.  
=====

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1821.

PROBATIONARY ESSAY

# AMPUTATION

IN CASES OF EXTERNAL INJURY;  
JAMES RUSSELL, ESQ. F. R. S. E.

ADMITTED  
FELLOW OF THE ROYAL COLLEGE OF SURGEONS  
AT THE AUTHORITY OF THE PRESIDENT AND HIS COUNCIL

SENIOR PROFESSOR OF ANATOMY AND SURGERY IN THE UNIVERSITY  
THE EXAMINATION

of the  
Royal College of Surgeons of England

JAMES RUSSELL, ESQ.  
FELLOW OF THE ROYAL COLLEGE OF SURGEONS

ADMITTED  
FELLOW OF THE ROYAL COLLEGE OF SURGEONS

IN ACCORDANCE WITH THEIR REGULATIONS RESPECTING THE ADMISSION  
OF CANDIDATES

FOLLOWING ESSAY

ON  
AMPUTATION

AS A CANDIDATE FOR THE DEGREE OF



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TO  
JAMES RUSSELL, ESQ. F. R. S. E.

FELLOW OF THE ROYAL COLLEGE OF SURGEONS,

AND

REGIUS PROFESSOR OF CLINICAL SURGERY IN THE UNIVERSITY  
OF EDINBURGH,

AND

JOSEPH BELL, ESQ.,

FELLOW OF THE ROYAL COLLEGE OF SURGEONS,

AND

ONE OF THE SURGEONS TO THE ROYAL INFIRMARY,

THE

**FOLLOWING ESSAY**

IS RESPECTFULLY DEDICATED,

AS A MARK OF GRATITUDE AND ESTEEM,

BY THEIR MUCH OBLIGED PUPIL,

THE AUTHOR.

William Brown Esq. with  
every good wish from the Author.

JAMES RUSSELL, ESQ. F. R. S. E.

FELLOW OF THE ROYAL COLLEGE OF SURGEONS

AND

REGIUS PROFESSOR OF CLINICAL SURGERY IN THE UNIVERSITY

OF EDINBURGH

INTRODUCTION

AND

JOSEPH BELL, ESQ.

FELLOW OF THE ROYAL COLLEGE OF SURGEONS

AND

Amputation being a great part of the Surgeon's business, as it is one of those operations by the help of which he is to perform, on account of the many fatal accidents and diseases to which the extremities are liable. These render it necessary, in many cases, to have recourse to the following Essay, in which the very principles of the operation are explained, and the manner in which they ought to be performed, and many of those who have been distinguished by the very high rank of the profession, have been distinguished in their most noble and successful operations, and have been distinguished as a MARK OF GRATITUDE AND ESTEEM.

BY THEIR MOST OBLIGED PUPIL,

In almost every case of injury to the extremities, there is a certain mark, or sign, which is to be observed, and which is a certain evidence of the nature of the injury, and which is to be observed in the following manner. For this reason, it is necessary to be acquainted with the signs, in which the nature of the injury is to be observed, and which is to be observed in the following manner. For this reason, it is necessary to be acquainted with the signs, in which the nature of the injury is to be observed, and which is to be observed in the following manner.

## INTRODUCTION.

AMPUTATION merits a great share of the Surgeon's attention, as it is one of those operations he is most frequently called to perform, on account of the many fatal accidents and diseases to which the extremities are liable. These render it absolutely necessary, in order to save the lives of the individuals to whom they occur; and many of them who have appeared at the very brink of dissolution, have been recovered by it, even in its most severe and dangerous form, that of Amputation at the hip joint, or of two limbs at the same time.

In almost every case of injury of the extremities, there is certainly much greater difficulty in deciding upon the necessity and expediency of Amputation, than in the actual performance of it. For this reason, it is intended in the following Essay, to dwell more particularly upon an enumeration of those cases in which this operation is necessary, than upon the modes of performing it.



## INTRODUCTION.

There is no class of cases, where the knowledge and judgment of a Surgeon are more called for, or more tried, than in deciding upon the necessity for Amputation in patients who have received severe injuries of any of the extremities. For in these cases, a decision must be immediately formed; as, on the one hand, the life of the patient may be in such danger, that, if Amputation be not immediately performed, his sufferings may rapidly increase from the severity of the injury, which there may be no opportunity of relieving before death ensues. And on the other, there is a risk of an unnecessary operation, which maims and mutilates him, and by which he is subjected to pain and suffering, and exposed to the risk of circumstances, which may prove fatal. In this latter case, such a measure, unless indispensable to his safety, would be severe and cruel, and wholly unjustifiable. And accordingly, to discriminate those cases in which this necessity occurs, involves one of the nicest and most important points in practice.

In the following pages, therefore, it is intended to state, as particular<sup>ly</sup> as possible, those cases, and the circumstances attending them, which appear to call for the performance of Amputation.

## Part First.

### OF AMPUTATION IN CASES OF EXTERNAL INJURY IN GENERAL.

It is now established by experience, that severe injuries of the extremities, which would soon prove fatal, may be resolved into a simple wound by Amputation; and the life of the individual, in this way, saved; and, also (a circumstance which is very probable,) that far more persons have died, from not having the operation performed, than from the operation itself.\*

In injuries of the extremities, there are two periods at which Amputation may be performed, either at a short interval after the accident, when the system has recovered from the immediate shock of the injury, and which is termed, *Primary, or Immediate Amputation*; or, after the lapse of several days, or weeks, when the inflammatory symptoms which succeed the injury, have either terminated in gangrene, or have subsided, and which has been termed, *Secondary Amputation*.

The period at which the operation should be performed, must be determined by the nature and circumstances of each individual case; the situation, extent, and severity of the injury, and the circumstances in which the patient is placed.

But when a case occurs, in which there is no doubt of the necessity of Amputation, certainly the sooner the operation is performed, the better for the patient; for when it is delayed

\* See Guthrie on Amputation.

death may ensue before an opportunity is afforded for performing the secondary Amputation. And even at best, in the most favourable progress of the case, the patient, by the delay, suffers much anxiety from his own fears, pain, and exhaustion, arising from the consequent Inflammation and fever; besides being subjected to the risk of Hoemorrhage, Gangrene, and Mortification, which may prove fatal. And, even if he escapes these, and an opportunity is afforded for performing secondary Amputation, it has been found, that this delayed operation is much more unfavourable for the patient, from several causes; and the Surgeon may then be reduced to the disagreeable alternative of, either proceeding to the operation, without any hopes of success, or of giving up all thoughts of it, and allowing the patient to die, without any effort to save him, being made.

Many of the older Surgeons were advocates for the delayed Amputation in all cases. But the army Surgeons, who of late years, from their accurate observation, and extensive experience, have become strenuous advocates for the primary Amputation, have improved this part of surgery very materially; as, by such prompt measures, many lives have been saved, which otherwise would probably have been lost; and as they have found, that much more danger to the life of the patient, arises from the secondary, than from the primary operation; and this from various causes.\*

Some of the modern Surgeons† have also given a preference to delayed Amputation, in cases of injury in full and robust persons; but this opinion seems to merit no attention,

\* See Guthrie on Amputation.

† See Note by Sir J. Earl on this subject, in his edition of Pott's Works.

Kirkland also seems to prefer delay in all cases. See his Observations on Pott on Fractures, p. 41.

for, when there is more danger to be apprehended from the operation, than from the injury, in general the operation will not be necessary, as the sole purpose of it is, to save the life and to mitigate the sufferings of the patient. And further, the numerous Amputations which have lately been performed in Military practice, upon robust men, and in a high state of health, with such beneficial effects, show that there is no particular or immediate danger in the operation. Most commonly too, the purpose of the operation, is to avoid the danger of a fatal result of the injury, before another opportunity is afforded for the performance of it. Immediate Amputation, therefore, is, in many cases, not only proper, but indispensable.

For the above reasons it must appear evident, that Amputation should never be delayed, unless with the well-grounded hope of saving the limb, and the life of the patient, without so desperate a measure.

There is great difficulty, (as has been already mentioned,) in deciding the important question—Whether or not this operation is absolutely necessary in any given case, as no fixed and invariable rules can be laid down, by which a Surgeon may be infallibly guided: for no two cases ever occur, in all respects, alike. And although an injury may be so severe as to come under the best rules for Amputation, yet still the concurrence of several favourable circumstances, may warrant the Surgeon to deviate from the general practice, so that, upon the whole, in the determination of it, much must be left to his judgment and discretion. In illustration of this, the following passage may be quoted from the work of a Surgeon, who seems to have had great experience in such cases, and a man of unwearied zeal and enthusiasm in his profession. “There is no possibility,” says Mr John Bell,\* “of defining before-

\* Treatise on Wounds, Edition I, Part III, p. 59.

hand, any future case ; there is no possibility of conceiving, and marking the various degrees of injury, and the various combinations of contingent circumstances, for the constitution of the patient, his accustomed way of life, his former diseases, or his present health, his state of mind, his alarm or his coolness, the absence or presence of fever, the conveniencies or hardships of his present situation, even the manner of his fall, and the degree and form of the injury ; in short, a thousand indescribable circumstances, must affect the Surgeon's judgment ; so that there can be no specific case described, no absolute rule delivered ; each accident is an individual case, and the conduct of it, together with the safety of the patient, is to rest entirely on the discretion and abilities of the Surgeon."

But although much must depend on the discrimination, skill, and discretion of the practitioner, an attempt may here be made to specify some of those rules, which the result of general practice seems to sanction and establish, as principles upon which he may act.

Many cases occur, of injury of the extremities, in which, from their nature and severity, there can be no doubt as to the propriety and necessity for immediate Amputation. In other cases again, where there would be no doubt as to the propriety of the primary operation in the field of battle, in civil practice it would be proper to delay it. These are cases, where it is probable that the Surgeon may be able to save the limb by great care and attention. This probability arises from the circumstance that in civil life, the patient has many comforts, which a soldier cannot get ; and he is therefore in a much more favourable situation for the cure of such an injury than the latter ; and also, because he is exposed to no risk from that frequent change of place to which a soldier is necessarily subjected. And there are also other cases in which it is proper to delay Amputation, either in the field, or in civil prac-

tice, from an expectation of being able to save the limb ; at the sametime having the alternative in view, of performing the secondary operation, should other means prove fruitless.

The performance of the operation must necessarily be delayed a few hours in most cases, as these severe accidents are generally followed by a low state of the system, or a depression of the living powers ; at which time the performance of any operation would be highly dangerous, if not fatal. When in this state, the patient rather requires to be revived, by cordials and external warmth.

By acting in the above manner, in incurable cases, we may prevent the life of the patient from being exposed to danger, we save him much suffering and anxiety, and we operate upon him before his strength is in the least impaired, or the parts on which we have to operate, have undergone any change from inflammation ; a time, at which he has by far the best chance of recovery. And, in doubtful and more favourable cases, we give the patient a chance of recovery without the loss of the limb.

This unquestionably, is the utmost which human prudence or foresight, is capable of doing for alleviating the sufferings of our fellow creatures. For no man can say, in many cases, where he thinks Amputation is necessary, that the limb is quite incurable ; he only means, (to use the language of Mr Pott, when treating of compound fractures,) “ that, from the experience of all time, it has been found, that the attempts to preserve limbs so circumstanced have most frequently been frustrated by the death of the patients, in consequence of such injury ; and that, from the same experience, it has been found, that the chance of death from Amputation, is by no means equal to that arising from such kind of fractures.”\*

\* See Pott on Fractures.

As we must therefore Amputate in many cases as a measure of prudence, it must of course happen, that some limbs may be Amputated which might possibly have been saved, and some left perhaps which should have been Amputated; but still it has been found, that a much larger proportion of lives will be saved in the long run by the primary operation;\* and it would certainly be imprudent and wrong, to attempt saving a man's limb at the risk of his life, which would be a false kind of humanity, misleading the judgment of the Surgeon, who, "though sensible of the extreme danger of the case, often lingers in expectation of saving the limb, till the fever and fatal gangrene come on."† And, as Mr Pott remarks, it shows more rashness, than there would be in Amputating the limb.‡

Seeing then that it is often necessary and proper to Amputate in cases of injuries done to the limbs, I shall now endeavour to point out these cases wherein it is requisite; and, in doing this, I shall mention the injuries of the different *textures* of the limbs; and also those of the different *regions*, separately, as the injuries of some of these are much more dangerous than those of others.

I shall also mention the cases and circumstances attending them, which seem to require *immediate Amputation*, separately from those, in which it may either be delayed, or in which *secondary Amputation* may become necessary.

\* See Guthrie's tables of cases of Amputation.

† J. Bell's principles of Surgery.

‡ See note in treatise on compound fractures concerning La Motte's case.

## Part Second.

### OF PRIMARY OR IMMEDIATE AMPUTATION.

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#### SECTION FIRST.

##### *Of Amputation necessary for Extensive Wounds of the Soft parts,*

In all cases where the integuments and muscles of a limb are extensively lacerated and detached, as by a gun shot wound, bruise of a waggon-wheel, &c. immediate Amputation should be performed. For, when this has not been done in such cases, it has been found that the life of the patient is subjected to very considerable danger, from the fever caused by the extent of the Inflammation that necessarily ensues,\* as well as from Mortification and Hæmorrhage which are very apt to supervene; particularly in gun shot wounds, which are always more severe and dangerous than wounds in the same parts from other causes, as they have several peculiarities. † When the patient escapes these dangers and survives the first attacks, his strength is soon exhausted by the profuse-

† These have been observed and pointed out by all the army Surgeons who have written upon the subject. The danger of these wounds, and the misery of the patient during their tedious cure, is well described by Mr John Bell, in his treatise on wounds. See part III. p. 4th, Edition I.

\* A case is mentioned by Mr Lawrence of London, (Medico-chirurg. Trans. vol. 6,) where the principal injury was an extensive separation of the integuments from the subjacent parts of the leg, in which Amputation was necessary. And another was mentioned to him by Mr Cline, in which this separation of the integuments of the thigh was the sole injury; and the man died within 24 hours after receiving it, so that Mr L. expresses his opinion as to the necessity for Amputation in very strong terms. Boucher expresses a similar opinion Mem. de L'Acad. de chirurgie, tom. II. Edition 4th. I myself have also seen several hair breadth escapes from similar injuries, in which primary Amputation had not been thought necessary, but where secondary Amputation was afterwards performed.



ness of the suppuration, or diarrhea and hectic fever. And he is subjected to this risk, with only a possible chance of a tedious and distressing cure, followed by his obtaining a useless limb, from contractions and adhesions which must take place in many of its moving powers; and secondary Amputation, (which is generally necessary, if we have an opportunity of attempting it,) is performed under very unfavourable circumstances, and often in diseased parts.

Immediate Amputation is also necessary, when a large portion of the soft parts has been removed, and when the bone has been denuded to any considerable extent, or if any of the large vessels or nerves are injured.

Cases of extensive wounds, however, when they are not very severe, (I mean not very deep or much lacerated, and without injury to any very important part,) admit rather of delay, and the secondary Amputation should be performed, if any of the circumstances, to be afterwards mentioned as requiring this operation, should occur.

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## SECTION SECOND.

### *Of Amputation necessary from Compound Fractures.*

Compound fractures of the extremities, when caused by gun shot wounds, a heavy body falling upon the limb, or by its being crushed, (as by a carriage wheel passing over it,) are generally of so severe and dangerous a nature, as to render immediate Amputation very frequently necessary.

The danger in these cases arises from the bones not only being broken, but in general shattered, and the neighbour-

ing parts lacerated and contused; and these circumstances give rise to a very high degree of fever, which is generally fatal within a few days. Even although this event does not take place, and the patient is so fortunate as to survive the fever, the injury is quite incurable from the impossibility of uniting shattered bones. There is also a very great risk of Gangrene supervening to the Inflammation. Besides, if much injury has been done to the soft parts, the constitution of the patient will be undermined, and his strength exhausted by the profuseness of the discharge of matter, the slow progress of the cure, and other circumstances, by which Hectic fever is induced; and which circumstances render the removal of the limb absolutely necessary sooner or later, as being the only chance which the patient has for life, in such unfavourable circumstances.

All Surgeons have considered these injuries to be of a very dangerous nature, \* and Mr John Bell speaks of them in the following strong terms: "In short, the parts are with difficulty regenerated; they are slow to heal, apt to run into ulcers, fistulas, and collections of matter; while the patient is exhausted by pain, fever, and profuse discharge."† "The bone or bones being broken into many different pieces, (says Mr Pott,) and that for a considerable extent, as happens from broad wheels, or other heavy bodies of large surface, passing over or falling upon such limbs; the skin, muscles, tendons, &c. being so torn, lacerated, and destroyed, as render Gangrene and Mortification the most probable and most immediate consequence; the extremities of the bones forming a joint being crushed, or as it were comminuted, and the ligaments connecting such bones being torn and spoiled, are, among others, sufficient reasons for proposing, and for performing

\* See Pott, Kirkland, Larry, Guthrie, Thomson, Hennen, Broomfield, &c.

† Principles of Surgery.

immediate Amputation. Reasons which, (notwithstanding any thing that may have been said to the contrary,) long and reiterated experience has approved; and which are vindicable upon every principle of humanity, or chirurgic knowledge.\*

These remarks are amply confirmed by the experience of others. The danger to the life of the patient is nearly the same in all severe injuries; it only differs in degree according to their extent and the nature of the parts injured, the strength of the patient, and the situation in which he is placed. By far the greatest danger, however, arises from injuries of the bones and joints. In these, the symptomatic fever is much greater; and indeed it is in general very soon fatal, when the injured parts are not removed. The life of the patient is also in immediate danger, from the Hæmorrhage or Gangrene which are very likely to supervene, in consequence of the injury done to blood-vessels and nerves, as well as from the high degree of Inflammation.

When immediate Amputation is not performed in such cases, the life of the patient is hazarded for a useless limb, (which is even the most favourable termination of the case,) obtained by a precarious, painful and tedious cure; with the great probability that, before it is completed, secondary Amputation will be necessary, from his constitution being so broken down, and his health so much impaired. The disease itself may also prove incurable, extensive abscesses being apt to form about the situation of the broken bone, which is very generally long of uniting, (if it unites at all,) from exfoliations and the displacement of its extremities, by which the discharge becomes more and more profuse, and

\* See Pott on Fractures.

great debility and hectic fever are thereby brought on. And "although the constitution should be strong, and so well managed, as even to bring the patient safely through all the dangers of a nine months cure, yet the limb so preserved, will be rather a burden than a help to the patient, who will sometimes, even after the cure has been accomplished, be obliged to have it cut off."\*

The following rules may be laid down as general principles, upon which the practice in the treatment of compound fractures may be founded. It must be kept in mind, however, that general rules may occasionally be liable to exceptions in particular cases, as has been already mentioned.†

Immediate Amputation seems to be indispensably necessary,

1. When a limb has been shot or torn off, any where below the hip or shoulder joint.
2. In all compound fractures, when the neighbouring soft parts have been much contused or lacerated, as by cannon balls, &c. or when the fracture is close to a joint.‡
3. In all compound fractures, when a large blood-vessel or nerve has also been injured.
4. In all compound fractures, when the injury is accompanied with the dislocation or injury of the neighbouring joint.
5. In all cases of compound fracture, when the bone or

\* See p. 53. part III. of John Bell's treatise on Wounds, Edition I.

† See p. 9.

‡ In this case, the joint partakes of the consequent inflammation.

bones are much splintered, or broken into fragments; even although the soft parts are apparently not much injured.

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### SECTION THIRD.

#### *Of Amputation necessary from Injuries of Joints.*

All Surgeons have agreed in thinking, that injuries of the larger joints are among the most urgent cases which call for immediate Amputation; for, when such an injury is great, it is attended with extreme danger and is quite incurable; when slighter, it is tedious in its progress towards a cure, and always renders the limb almost, if not entirely useless. In proof and illustration of this, it is only necessary to quote the following passage from the report of the wounded after the battle of Waterloo, by Dr Thomson, (whose talents, zeal, and professional knowledge demand the highest respect,) which clearly shows the very great danger of such injuries. Speaking of wounds of the knee joint, he says, "several had died of these wounds, and others were in imminent danger of doing so, before the symptomatic fever could undergo such an abatement as to warrant the Amputation of the limb." This shows the imperious necessity for primary Amputation in such cases; and it is amply confirmed by the concurring observation of others. It appears from experience, that the danger of those cases arises from the inflammation consequent upon the injury done to the capsular ligament and other parts composing the joint. "In the wounds of the knee," adds Dr Thomson, "almost all those who had *not* suffered Amputation, were in a very dangerous situation from inflammation and fever; extensive abscesses formed round the knee and extended up the leg, so that these were in a state quite unfit for undergoing any operation, which, for many of them, was the only chance of recovery."

“ It will be seen, (he also says in treating of wounds of the ankle joint,) from the account which I have already given of injuries of the knee joint, that examples of recovery, with preservation of the limb, were very rare; and, from the number who died in consequence of the inflammation and abscesses of the thigh, and from the great difference between the success resulting from the primary, and that from the secondary Amputation of the thigh, there seems every reason to conclude, that many lives might have been saved, were early Amputation uniformly practised in these injuries.”

The injuries of the ankle and other large joints appear to be no less dangerous, and some of them even more so.

“ Among a great number,” says Dr Thomson, “ who had survived the fever, we saw but few in whom secondary Amputation was not required; and, in cases requiring it, this operation was far from being so successful as the primary Amputation would have been.”

“ In the slighter wounds of the ankle joint,” he adds, “ in which the external parts only have been injured, Amputation may be delayed, with some prospect of recovery, by ankylosis, by the limb being long kept at rest in the horizontal position.”\*

A passage by the late Mr John Bell, upon the same point, may also be quoted for the sake of illustration:—“ I have just mentioned, that in luxation of the ankle joint, even the astragalus, the great bone of the joint, (a bone not inferior in size to the head of the thigh bone,) may be displaced, separated, and cut entirely away, and yet the limb saved; yet this is the case in which, according to my experience, Gan-

\* Report of the Wounded, &c.

grene is so apt, or rather so sure to happen, that those who have been saved after such an accident, have been saved by chance, while hundreds have died of the Gangrene, which usually ensues. A successful case now and then obtrudes itself upon our notice; but it is one case picked out of ten thousand."\*

In injuries of the larger joints of the extremities, immediate Amputation is necessary,

1. When the ligaments of a joint are lacerated, and the articulating surfaces of the bones are fractured, as by a bullet having passed through a joint, &c. †

2. When a joint is laid open by external injury, and particularly, when it is accompanied with a fracture of any of its component bones, or injury of any large blood-vessel or nerve.

3. When a joint is dislocated, accompanied with a fracture, as has been already mentioned.

4. When the component parts of a joint are much bruised, and the bones broken, as by a carriage wheel passing over it, or a wound by a spent or oblique ball, &c. although there should be no external injury or laceration.

\* Principles of Surgery, vol. I. p. 666.

† "In Belgium," says Dr Thomson in the above report, "some who had suffered this injury, died during the first attack of inflammation and fever; we saw some sinking more slowly under hectic fever and diarrhea; and of the remainder, a great proportion had passed, or were passing into a state, in which secondary Amputation affords the only chance of recovery."

## SECTION FOURTH.

*Of Amputation necessary from injury of Blood-vessels and Nerves.*

From the important functions which blood-vessels and nerves perform in every part of the system, the destruction or injury of any of them, when it is of a considerable size, is attended, as might be expected, with the most serious consequences.

As the instances of wounded arteries having been cured are extremely few, we cannot in any given case of such an injury, depend on this favourable issue; so that, now, no attempt is ever made to cure it by the healing of the wound; but one of two other practices must, without delay, be resorted to; the artery must either be tied above the place of the wound, or immediate Amputation must be performed.

There seems to be a difference of opinion among the highest authorities, which of these courses should be adopted; so that it is from the general result of experience alone, that a proper decision can be formed.

Dr Thomson, in the Report above-mentioned, says, (when speaking of Hæmorrhage,) "Several cases had occurred, in which it became necessary to tie the superficial femoral artery, in some of these, Gangrene of the foot supervened. In two cases, it was necessary, from secondary Hæmorrhage, to cut down, and tie the humeral artery; in the first, after several weeks, the pulse at the wrist had not returned; in the second, sphacelus of the fingers, and gangrenous inflammation of the fore-arm, were produced, and the arm was Amputated above the elbow." From this it may be inferred, that, in similar



cases, immediate Amputation should be performed, as being the most certain and safe way of saving the life of the patient.

“The principal trunk of the artery,” says Mr Bromfield, “either of the superior or inferior extremity being wounded, for the generality, requires the limb to be taken off.\*”

Upon the subject of wounded arteries, Mr John Bell comes to the conclusion, “that wounds of the axillary artery, like wounds of the femoral artery, are often dangerous from bleeding, but never fatal from the want of inosculation; that we should tie the greatest arteries of the body, confidently, whenever they are wounded, without the trunk of the body; and that we should tie the arteries as boldly at the groin, or in the axilla, as in the lesser branches, going down to the thigh or arm. Accidents, undoubtedly, (as we are in all our operations at the mercy of accident,) may prevent our achieving a cure.” This author thought, therefore, that a simple wound of any of the larger arteries of the limbs, should never be a reason for Amputation, as the artery might be tied with perfect safety to the limb, from the inosculating branches.

Mr Hodgson, when speaking of healing a wounded artery by adhesion, says, “nor indeed would any desireable object be gained, by preserving the canal of the vessel, for it is fully proved, that every part of the body is provided with a means of carrying on a collateral circulation, and that in general, there is no danger of a deficient supply of blood, when the main artery is tied in a healthy limb. It must be acknowledged, however,” he continues, “that the Mortification of a limb is a more frequent occurrence, after the ligature of a wounded artery, than when an artery is tied for the cure of

\* Chirurgical Observations, vol. i. p. 39

aneurism. This circumstance appears to be sometimes owing to the injury of the surrounding parts, and more particularly that which the veins and nerves have sustained from the accident.”\*

It was also the opinion of the late Mr John Hunter, that Amputation in cases of wounds should only be practised, when a large artery is injured so as to endanger the life of the patient, or when it is thought that the Inflammation consequent to the accident will be fatal.†

From all these statements it must appear evident, that tying the principal artery of a limb when it is wounded may sometimes be attended with success,‡ but that it will not with any certainty prevent the loss of the limb or life of the patient. The immediate Amputation of the limb, therefore, can alone be depended on, with any degree of certainty, for the safety of his life; and this practice is now established by experience to be the best. For, although the large arteries which supply the extremities have been tied with success in many cases of aneurism, where the course of the circulation in the limb must have undergone great changes, from the existence of the disease, yet the tying of a wounded artery in a limb otherwise sound has not been attended with similar success; Gangrene and Mortification being very apt to take place from one of two causes: either from a deficient supply of blood to the lower part of the limb, or from a high state of Inflammation produced by the wound. The first of these may be caused, partly by the smallness of the inosculation branches, partly from the swelling and Inflammation that take place at the situation of the injury, thereby preventing

\* See Hodgson on the Arteries, p. 478.

† See Hunter on Inflammation, &c.

‡ A case is mentioned by Mr J. Bell, in which the axillary artery was accidentally wounded, and which was tied with success, by a Mr Hall. See Treatise on Wounds, p. 59.

the blood from flowing readily to the parts below it,\* and sometimes also from the weakness of the patient, owing to his having lost a great deal of blood in consequence of the injury; and the latter by an overflow of blood to the limb and a plethoric state of the system, aggravating the Inflammation caused by the wound.

The above opinion, therefore, of Mr John Bell and part of that of Mr Hodgson must be considered as founded chiefly upon theory, as it is somewhat at variance with the experience of many of the most distinguished Surgeons. It must therefore be taken with limitation, and cannot, in the present state of our knowledge, be implicitly acted upon.

When the wound of a great artery of a limb is attended with injury of any of the other important parts, as the accompanying vein† or nerve,—fracture of the bone,—severe laceration of the flesh,—wound of the soft parts laying bare the bone, or an injury of the neighbouring joint, immediate Amputation is imperiously called for; as it is the only chance for the life of the patient being saved. Upon this subject Mr John Bell justly observes, “often, very often limbs are lost, when the femoral or humeral arteries are wounded with the clean cut of a knife. What issue then,” he continues, “are we to look for in a wound of the main trunk, attended with a bruised and gangrenous sore, and perhaps with broken bones.”†

**Wounds or injuries of the larger veins are never of them-**

\* For although there is an increased flow of blood to inflamed parts, they do not allow it to pass readily through them.

† Mr Guthrie says that when an artery is ruptured by a gun-shot wound, the vein is generally ruptured also; and he and Mr Hodgson both give it as their opinions, that whenever a large artery, and the accompanying vein, are wounded, Gangrene of the limb inevitably supervenes.

\* See Treatise on Wounds, Part III. p. 2.

selves a reason for the Amputation of a limb, though they are a very considerable aggravation to the injuries of other parts. I therefore proceed to speak of the injuries of nerves.

Mr C. Bell mentions a case, where the principal nerves of the arm were wounded. The wounds healed; but the limb became (to use his own words) “shrunk, stiff, powerless, and insensible; so that the patient afterwards wished to have it Amputated.” Upon this case the author very justly observes, that “the remark which this case naturally draws forth is, that when nerves are thus cut to the certain loss of sense and motion, when we are certain that the use of the limb cannot be regained; we find no adequate reward for carrying our patient through the tedious cure; it is better to Amputate in the first instance.”\*

The case of a man is mentioned, however, by Mr Weldon, in his surgical cases, whose ischiatic nerve was accidentally divided; the effect of which was a numbness and imperfect motion or power in the limb; these, however, gradually increased, and the author thought there was no doubt that at length it would perfectly recover.

Nerves of a considerable size also are sometimes intentionally, and others accidentally divided, without any dangerous consequences.†

From these statements, as it does not appear that, from the wound of a great nerve, either the life of the patient is in danger, or the taking place of Mortification of the limb, and as there is some reason to hope that a recovery may take place, it may be inferred, that primary Amputation is unnecessary; so that, at all events it may be delayed till some greater urgency of the case calls for it.

\* See Treatise on Wounds, by Charles Bell, p. 59.

† I allude to operations for Tetanus, Tic Douloureux, &c.

## Part Third.

### OF AMPUTATIONS NECESSARY FOR INJURIES OF PARTICULAR REGIONS OF THE LIMBS.

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#### SECTION FIRST.

##### *Of Amputation at the Hip joint.*

In cases of very severe injuries of the hip joint, as those inflicted by cannon shot, the system receives so severe a shock at the moment of their infliction, that they prove almost immediately fatal; and in such cases consequently there is no opportunity for operating. "From a gun shot wound," says Mr John Bell, "in the haunch bone, or in the femur near its neck, trochanters, or any where high up in the bone, not one of twenty escapes."\* This statement has been amply confirmed by more recent experience.†

There are many less severe cases, however, in which reaction and restoration of the system does take place; so that an opportunity for operating is thus afforded. In such cases, there is seldom an opportunity for performing the secondary operation; it must in general therefore be ~~performed~~ preferred immediately, or at least as soon as the system recovers from the shock of the injury.

Although this is a very formidable operation, and one dreadful to behold, it is not to be considered as one which is generally fatal, as many recoveries have been effected by it;‡ and, as in those cases where it seemed to be the immediate

\* See Principles of Surgery, vol. I.

† See Thomson, Guthrie, Hennen, &c.

‡ See Guthrie, Larrey, &c.

cause of death, it is probable that if any operation whatever had been performed, upon a patient in a similar state, that it would have been fatal, as well as the Amputation at the hip-joint, so that this circumstance, of its having been sometimes fatal, should not deter a Surgeon from performing it. The success of the operation, therefore, depends on the extent of the injury, and the strength of the patient, as upon these depends the degree of recovery from the immediate effects of the injury which he may have attained.

Dr Thomson thinks that this operation is best adapted to cases of gun-shot wounds; "for," he says, "the number of cures which have been obtained from Amputation at the hip-joint, is, I believe, much greater than of cures from gun-shot fracture of the head or neck of the thigh bone. Indeed of recoveries from these injuries, I know of none which have been recorded; those who, for a time, seem to do well, in the end sink under hectic which supervenes."\*

The danger of these fractures arises from several causes, the most frequent of which are, "the shock which the constitution receives at the moment of the injury—the high degrees of Inflammation and fever which are excited—the retardation of reunion of the fractured extremities of the bones which occur, and the numerous and extensive abscesses which almost always form in the course of the thigh, in the region of the hip joint and buttock;" and "there are often fissures down to the knee joint, which cause ulceration of its cartilages."†

Immediate Amputation at the hip joint is necessary,

1. In cases of severe compound fracture of the thigh bone,

\* See Report, &c.

† See Guthrie on Amputation.

when high up, or when the fracture is above its middle, and if it is much splintered or shattered,\* as this is the only chance the patient has for life; and more particularly, if any other important part is injured.

2. When the head and neck of the thigh bone are shattered by a gun-shot.

3. “When a musket bullet or grape shot, or small portion of shell has been observed to fracture the neck or head of the thigh bone, and pass through or lodge in the hip joint.”†

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## SECTION SECOND.

### *Of Amputation at the Thigh.*

Compound fractures of the thigh bone are always considered extremely dangerous, particularly those by which the bone is shattered; they are therefore among the most common cases of injury which demand immediate Amputation.

Mr' John Bell, in treating of gun-shot fractures, says, “when the bone is the largest in the body, and covered with a great thickness of flesh, as in the thigh, there is a very extensive destruction of parts; the mass of disease is very great, and if the patient escape Gangrene in the first days of the wound, he generally perishes afterwards from the fever, the incessant suffering, and the profuse discharge.”‡

In the small number of favourable cases that have recovered from this injury, the patients have only saved useless limbs, after a very tedious and painful cure.

\* Thomson, Guthrie, Larrey, &c.

† Thomson.

‡ Principles of Surgery, vol. I.

The danger attending compound fractures of the thigh, when the bone is shattered, or when they are combined with injury of some of the other important parts, is equally great, in whatever manner they are caused.

When such cases of injury occur therefore, immediate Amputation should in general be performed, as another opportunity for operating may never occur; and if it does occur, it will generally be performed under the most unfavourable circumstances. According to Mr Guthrie, more than one half of those died, who underwent the secondary Amputation. A far greater number, therefore, of lives and useful men have been saved who suffered such injuries, by the primary, than the secondary operation; one or other of which seems to be indispensably necessary.

Injuries of the large blood vessels, and laceration of the muscles of the thigh, likewise require the same operation.

Immediate Amputation at the thigh is also frequently necessary, from injuries of the knee joint, and those high up in the leg, which have always been observed to be attended with the most imminent danger, as was formerly mentioned.

Amputation at the thigh then, is necessary,

1. In cases of severe compound fracture at or below the middle of the thigh bone.

2. When the integuments and muscles of the thigh are extensively injured, laying bare the bone, or accompanied with injury to a principal blood vessel or nerve.

3. When the knee joint is so much injured that it is laid open, and its component parts lacerated or contused.



4. When a musket ball enters, and is lodged or passes through the knee joint.

5. When the femoral artery and vein are injured.

Amputation at the thigh is also sometimes necessary from similar injuries of the leg, when situated so high up that it cannot be performed below the knee.

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### SECTION THIRD.

#### *Of Amputation at the Leg.*

Primary Amputation at the leg is rendered necessary, from severe compound fractures of the bones of the leg and foot; fractures combined with injuries of the muscles, principal blood vessels or nerves, or a dislocation of the ancle joint; and also from injuries of the ancle joint or foot.

It appears necessary to Amputate immediately at the leg, in the following cases, in the field of battle,

1. In cases of gun-shot wound when both bones of the leg are fractured.

2. When the tibia is fractured close to the ancle joint.

3. In gun-shot fractures of the tibia or astragalus, with a dislocation of the ancle joint.

4. In cases where the tibia is fractured, with a wound of any of the principal arteries of the leg, if the Hœmorrhage cannot be stayed, without further injury to the limb.

5. When there is an extensive wound of the soft parts accompanied with profuse Hæmorrhage.

6. When a bullet has lodged or passed through the ankle joint.

7. When the foot has been shot away; or when the bones of it are much bruised or shattered.

Compound fractures of the tibia, even although they are severe, and a portion of the bone has been removed, do not require immediate Amputation, as patients frequently recover from this injury with useful limbs. In cases of this kind, therefore, it may be delayed.

In civil practice, similar injuries to those above mentioned, unless when they are very severe, will not, in general, require immediate Amputation; for, in this part of the body they are not attended with such imminent danger; besides, in this situation they can be treated with much more care, their progress more carefully watched, and the alternative of the secondary Amputation can be performed, if, in their progress, circumstances requiring it should occur.

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#### SECTION FOURTH.

##### *Amputation at the Shoulder Joint.*

Wounds in the region of the shoulder joint, like those of other large joints, are attended with excessive danger; and this danger is greatly increased from the wound being in the vicinity of so many important parts.

Primary Amputation at the shoulder joint is not attended

with any particular danger, and it is, in many cases, the only chance which the patient has for surviving severe injuries. The safety of the secondary operation, at this part, however, cannot be so much relied upon, even when the patient does survive the injury; and more particularly as incisions must be made in recently inflamed and unsound parts. "In Belgium," says Dr Thomson, "almost all of those recovered who had undergone the primary Amputation at the shoulder joint, while fully one-half died of those on whom it became necessary to Amputate at a later period."

Immediate Amputation at the shoulder joint appears to be necessary,

1. When the capsular ligament is penetrated, along with a fracture of the head of the humerus, or when the axillary artery is wounded.
2. When the humerus is fractured, and splintered at its upper extremity, with injury of the soft parts.
3. When the shoulder joint is laid open, with much injury of the soft parts.
4. When a bullet has passed through, or has injured any of the articulating surfaces of the joint.
5. When the axillary artery, or upper part of the brachial artery, is wounded, with an extensive laceration of the soft parts, fracture of the bone, injury of the vein, or any of the large nerves.

In these last cases, however, if the artery can be readily tied, and if the injury done to the neighbouring parts is not so great as to render immediate Amputation necessary, it may

be delayed. But as there is reason to fear Gangrene from a deficient supply \* of blood to the arm, the case must be carefully watched, and treated according to circumstances. The following are the directions given by Mr Guthrie for treating such cases: "If then, even in the most favourable case, the appearance of returning circulation in the hand should not be evident, after a few hours delay, but, on the contrary, it gradually becomes colder and painful, with some subsequent numbness and flaccidity, and all the appearance of approaching gangrene, the operation (Amputation) should be resorted to, without further delay, before any considerable inflammation takes place, or gangrene has established itself in the whole limb."

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#### SECTION FIFTH.

##### *Of Amputation at the Arm and Fore-Arm.*

Primary Amputation, at the *superior* extremity, is not so frequently necessary from injuries, as when these occur in the *inferior* extremity, and this for several reasons. The limb being smaller, the injury is generally of less extent, consequently the inflammation and derangement of the patient's constitution must be less; his health will not suffer from being extended, for many months, upon a bed, as he may, in general, get up and go about a little, whenever the fever is over; and it may also be delayed, as it does not appear that there is so much difference, in the ultimate success, between the primary and the secondary Amputation of the upper, as of the lower extremities.

Immediate Amputation at the arm is necessary,

\* From the causes mentioned at page 23.

1. In cases of extensive laceration of the soft parts of the arm, accompanied with a wound of the humeral artery, or when any considerable part of the bone is laid bare.

2. In cases of severe compound fracture of the humerus, or high up in the bones of the fore-arm, particularly when it is combined with injury of the elbow joint.\*

Injuries of the fore-arm do not seem to require immediate Amputation, unless they are of a very severe nature; such as a compound fracture of both bones, with injury of some of the large blood vessels or nerves, or when the hand is shattered by a gun-shot, or severely bruised by a heavy body falling upon it. In their progress, however, they may require secondary Amputation, if any of the circumstances afterwards to be mentioned occur.

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## Part Fourth.

### OF SECONDARY AMPUTATION.

When immediate Amputation has not been performed in injuries of the extremities, from an expectation of recovery without such a measure, several circumstances may occur to render secondary Amputation necessary to save the life of the patient. These are Hæmorrhage, Mortification, Profuse Suppuration, or the Formation of extensive Abscesses, the want of Re-union of fractured bones, Hectic Fever, Hospital Gangrene, and Tetanus.

\* I recollect to have seen a middle-aged man, whose elbow joint was bruised and lacerated by a carriage-wheel having passed over it; he would not allow it to be taken off, and he died within twenty-four hours after the accident.

## SECTION FIRST.

*Of Amputation on account of Hæmorrhage.*

Hæmorrhage is often one of the most dangerous consequences of wounds; and, when it takes place from arteries even of a very considerable size, it may meet with a temporary cessation, and re-commence at some distance of time after the injury, to such a degree, that a wound, which was not considered to be dangerous, may become highly so, unless the flow of blood can with facility be stopped, and thus Amputation may be rendered necessary.

Secondary Hæmorrhage, attended with danger, not unfrequently takes place also in wounds from sloughing and ulceration either of a large vessel or a great number of small ones, which may also render Amputation necessary.

Continued Hæmorrhage, from a lacerated or shattered limb, can never leave a doubt as to the propriety of Amputation.

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 SECTION SECOND.
*Of Amputation on Account of Mortification.*

Mortification or Gangrene, in cases of external injury, has been distinguished by surgeons into that which arises from the state of the system, and that arising entirely from the local injury;\* as well as into that which is spreading, from that which is defined. Any of these species of the affection may take place within a day or two after the injury, or not till a much later period.

\* See Kirkland on Amputation, Larrey, Mem. de Chirurg. Militaire, &c.

When it arises from the *first* of the causes above mentioned, it has been found, that Amputation performed before its progress has stopped, is of no avail, but that it hastens the death of the patient. When a line of separation, however, has made its appearance, Amputation should immediately be performed at the line of separation, to facilitate the cure.

But if the Gangrene is owing to the injury, Amputation should be performed whenever it has made its appearance, a practice which has only of late been adopted by the army surgeons, and confirmed by their experience, contrary to the former opinions of the most distinguished surgeons.\* When it has been induced by ruptured blood-vessels, Mr Guthrie mentions that he does not wait for a line of separation appearing, but Amputates immediately at the seat of the wound, whenever it appears to have taken place at the extremity of the limb.† M. Larrey is precisely of the same opinion, and he mentions that “there is no reason to apprehend, that the stump will be seized with gangrene, as in the spontaneous mortification, that has not ceased to spread,” and after mentioning what he considers to be reason of this, he adds, that “Amputation, performed in a proper situation, stops the progress and fatal consequences of the disorder.”‡

Cases of spreading gangrene are also mentioned by Mr Laurence, in which he performed Amputation, although it appeared to be spreading rapidly, with the most perfect success.§ This practice, therefore, seems now to be sufficiently established.

In cases, also, where there has been a great loss of sub-

\* See Bromfield, Sharp, Pott, &c.

† See Guthrie on Amputation.

‡ Mem. de Chirurg. Militaire, tom. III.

§ See Medico Chirurg. Transactions, vol. VI.

stance, from partial sloughing, or hospital gangrene, laying bare the bones, &c. secondary Amputation may be necessary.

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### SECTION THIRD.

*Of Amputation on account of Profuse Suppuration, or the formation of extensive Abscesses.*

When the constitutional strength of a patient appears to be sinking in consequence of the profuse discharge from a wound, whether from the injury, sloughing of the soft parts, or the formation of abscesses, Amputation of the limb is the only chance that he can have for recovery.

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### SECTION FOURTH.

*Of Amputation on account of the want of Re-union between the extremities of Fractured Bones.*

The want of re-union of the extremities of broken bones, at a considerable time after the injury, may arise from several different causes:—The want of a disposition in the parts to pour out callus—the bone being shattered as well as broken—a portion of the soft parts of the limb getting between the broken extremities—or the obliquity of the fracture.

When it arises from the first of these, the friction of the broken parts simply rubbing upon each other, has often been attended with success in producing a union, or causing a new irritation by the introduction of a seaton between the extremities of the bone, as has been lately successfully practised in two cases by Mr James Wardrop, and also in other two by



Mr Brodie.\* It can rarely happen from the second; as such injuries in which a bone is shattered, generally require primary Amputation; but when it does occur, there can be little doubt as to the propriety of Amputating the limb. When it arises from any of the two last mentioned causes, instead of performing Amputation, it would perhaps be better to saw off the ends of the fractured bone, in the manner successfully performed by Mr Rowland of Chester.†

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#### SECTION FIFTH.

##### *Of Amputation on account of Hectic Fever.*

When hectic fever is caused by the profuse discharge of matter and irritation from an injury of any of the extremities, so that the patient is progressively sinking, there can be no doubt as to the expediency of removing the limb; by which in all probability the patient's life will be saved.

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#### SECTION SIXTH.

##### *Of Amputation on account of Hospital Gangrene.*

In some severe cases of this disease, Amputation has been resorted to, but most commonly without success.‡

\* See Medico Chirurg. Transactions, vol. V.

† See Medico Chirurg. Transactions, vol. II.

‡ See Blackadder on this Subject.

## SECTION SEVENTH.

*Of Amputation on account of Tetanus.*

When symptoms of Tetanus appear from an injured nerve, the removal of the injured part has been recommended; M. Larrey gives many cases in which he performed Amputation of the limbs with the most perfect success, for this affection. From the dangerous and untractable nature of this disease, therefore, this measure must be had recourse to when, from the extent of the injury, it is impossible to divide the particular injured nerve which is the cause of the disease; as there is no way by which it can be discovered or when it is so large that the division of it might be attended with dangerous consequences. But in cases when the injured nerve can be found, and when it is of a small size, the division of it may be quite sufficient. Mr Wardrop of London lately mentioned to me two cases of injury, where symptoms of Tetanus appeared, and in which he divided the nerves with the most perfect success.

FINIS.







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